CLAIMS

~~31~~. A method of producing a ceramic material comprising the steps of:

- providing a **sintered** structural mass that has an open microporosity and that is made of a refractory compound selected from borides, aluminides and oxycompounds, and combinations thereof; and

- impregnating the open microporosity **of the sintered structural mass** with colloidal and/or polymeric particles of iron oxide and/or a heat-convertible precursor thereof,~~.~~

**the colloidal and/or polymeric particles forming upon heat treatment compact sintered agglomerates in micropores of the structural mass.**

~~32~~. The method of claim ~~31~~, wherein the colloidal and/or polymeric particles are sintered in the open microporosity of the structural mass by a heat treatment.

~~33~~. The method of claim ~~31~~ or ~~32~~, wherein the structural mass is formed by sintering a ceramic particulate.

~~34~~. The method of claim ~~33~~, wherein the ceramic particulate is suspended in a slurry which is dried before sintering.

~~35~~. The method of claim ~~34~~, wherein the slurry comprises a colloid and/or a polymer.

~~36~~. The method of claim ~~35~~, wherein the slurry comprises: colloidal particles selected from lithia, beryllium oxide, magnesia, alumina, silica, titania, vanadium oxide, chromium oxide, manganese oxide, iron oxide, gallium oxide, yttria, zirconia, niobium oxide, molybdenum oxide, ruthenia, indium oxide, tin oxide, tantalum oxide, tungsten oxide, thallium oxide, ceria, hafnia and thoria, and precursors thereof, all in the form of colloids; and/or polymeric particles selected from lithia, beryllium oxide, alumina, silica, titania, chromium oxide, iron oxide, nickel oxide, gallium oxide, zirconia, niobium oxide, ruthenia, indium oxide, tin oxide, hafnia, tantalum oxide, ceria and thoria, and precursors thereof, all in the form of polymers.

~~37~~. The method of any one of claims ~~34~~ to ~~36~~, wherein the slurry comprises at least one organic compound selected from ethylene glycol, hexanol, polyvinyl alcohol, polyvinyl acetate, polyacrylic acid, hydroxy propyl methyl cellulose and ammonium polymethacrylate and mixtures thereof.

**8. A ceramic material obtainable by the method of any one of claims 1 to 7,** comprising a structural mass made of at least one refractory compound selected from refractory borides, aluminides and oxycompounds, and combinations thereof, said structural mass having an open microporosity that is impregnated with colloidal and/or polymeric particles of iron oxide and/or a precursor of iron oxide **which when heat treated form compact sintered agglomerates in micropores of the structural mass and promote, ~~said particles promoting~~** wetting of the structural mass by molten aluminium and/or forming upon heat treatment a sintered barrier against oxygen diffusion through the structural mass.

9. The material of claim 8, wherein the structural mass comprises one or more oxycompounds selected from: refractory oxynitrides, oxycarbides, oxyfluorides and metal oxides.

10. The material of claim 8 or 9, wherein the refractory compound comprises one or more borides, aluminides and oxycompounds of at least one metal selected from titanium, niobium, tantalum and molybdenum.

11. The material of any **one of ~~preceding~~** claims **8 to 10,** wherein the colloidal and/or polymeric particles are made of at least one of $FeO(OH)_2$, FeO, $Fe_2O_3$ and $Fe_3O_4$ and precursors thereof, all in colloidal and/or polymeric form.

12. The material of any **one of ~~preceding~~** claims **8 to 11,** comprising a catalyst to promote the formation of magnetite from the colloidal and/or polymeric particles during heat treatment, in particular a catalyst made of a copper compound such as copper oxide.

13. The material of any **one of ~~preceding~~** claims **8 to 12,** wherein the colloidal and/or polymeric particles are sintered in the open microporosity of the structural mass.

14. The material of any **one of ~~preceding~~** claims **8 to 13,** which is a coating on a substrate.

15. The material of any one of ~~preceding~~ claims 8 to 13, which is a self-sustaining body.

16. A component which during use is exposed to an oxidising atmosphere, said component having a substrate that is protected from oxidation by a ceramic barrier layer made of a material as defined in claim 14, in particular when depending on claim 13.

17. The component of claim 16, which is an anode for the electrowinning of aluminium, the ceramic layer being covered with a protective layer that inhibits dissolution of said ceramic layer.

18. The component of claim 17, wherein the protective layer comprises at least one of: iron oxides, such hematite and/or nickel ferrite; and cerium oxycompounds, in particular cerium oxyfluoride.

19. The component of claim 17, wherein the protective layer contains at least one of: copper; nickel; silver; copper oxide; and nickel oxide, the protective layer being covered with an electrochemically active surface layer.

20. The component of any one of claims 16 to 19, wherein the substrate is metal-based.

21. The component of claim 20, wherein the metal-based substrate contains at least one metal selected from chromium, cobalt, hafnium, iron, molybdenum, nickel, niobium, platinum, silicon, tantalum, titanium, tungsten, vanadium, yttrium and zirconium.

22. The component of claim 21, wherein the substrate contains an iron alloy of nickel and/or cobalt.

23. A component which before use or during use is exposed to molten aluminium, said component having an aluminium-wettable surface formed by the ceramic material of any one of claims 8 to 15.

24. The component of claim 23, which is made of said ceramic material or which comprises a layer of said ceramic material on a substrate, in particular a carbon substrate.

25. The component of claim 23 or 24, which is a cathode, a cell bottom or a sidewall of an aluminium electrowinning cell.

26. The component of claim 23 or 24, which is an arc electrode or a holder for an arc electrode.

27. The component of claim 23 or 24, which is a component of an apparatus for treating molten aluminium, in particular a stirrer for stirring molten aluminium, a pipe for supplying a treating agent to molten aluminium, or a vessel for containing molten aluminium.

28. A cell for the electrowinning of aluminium from alumina dissolved in a molten electrolyte, which cell comprises: a cathode; and at least one component as defined in any one of claims 16 to 22 which is an anode and which has a substrate that is covered with said ceramic barrier layer and said protective layer.

29. The cell of claim 28, comprising a component as defined in claim 16 or 17 that forms said cathode or a sidewall.

30. A method of electrowinning aluminium in a cell as defined in claim 28 or 29, which method comprises passing an electrolysis current from the cathode to the anode through the molten electrolyte to electrolyse the dissolved alumina whereby aluminium is produced on the cathode and oxygen is evolved on the anode, the ceramic barrier layer inhibiting oxidation of said substrate by the evolved oxygen.

31. A cell for the electrowinning of aluminium from alumina dissolved in a molten electrolyte, which cell comprises: an anode; and at least one component as defined in claim 23 or 24 which is a cathode and which has an aluminium-wettable surface.

32. The cell of claim 31, comprising a component as defined in any one of claims 17 to 22 which is an anode.

33. A method of electrowinning aluminium in a cell as defined in claim 31 or 32, which method comprises passing an electrolysis current from the cathode to the anode through the molten electrolyte to electrolyse the dissolved alumina whereby aluminium is produced on the cathode and gas is evolved on the anode, the aluminium-wettable surface being wetted by aluminium.

34. An arc furnace comprising at least one component as defined in claim 26, which component has an inactive surface that is aluminium-wetted.

35. A method of operating the arc furnace of claim 34, said at least one component being an arc electrode, the method comprising passing an electric current through the arc electrode, the aluminium-wetted surface protecting the arc electrode's inactive surface against oxidation.

36. An apparatus for treating molten aluminium comprising at least one component as defined in claim 27, said component being a stirrer, a pipe or a vessel.

37. A method of operating an apparatus as defined in claim 36, said component being a stirrer, a pipe, or a vessel, said method comprising when the component is a stirrer, a pipe or a vessel, respectively: stirring molten aluminium with the component; supplying a treating agent to molten aluminium through the component; or confining molten aluminium in the component.

~~38. A ceramic material comprising a structural mass made of a refractory compound selected from borides, aluminides and oxycompounds, and combinations thereof, said structural mass having an open microporosity that is impregnated with colloidal and/or polymeric particles of iron oxide and/or a precursor of iron oxide.~~

~~39. The ceramic material of claim 38, wherein the colloidal and/or polymeric particles are present in the open microporosity with or without sintering and constitute an agent to promote wetting of the structural mass by molten aluminium.~~

~~40. The ceramic material of claim 38, wherein the colloidal and/or polymeric particles are sintered in the open microporosity of the structural mass to form a sintered barrier against oxygen diffusion through the structural mass.~~

~~41. A method of providing an aluminium wettable component, comprising forming a surface of the component with a ceramic material as defined in claim 38 before exposure of the component to molten aluminium.~~

~~42. A method of protecting a substrate against oxidation, comprising covering the substrate with a ceramic material as defined in claim 40 and sintering said colloidal and/or polymeric particles in the open microporosity of said structural mass to form a sintered barrier against oxygen diffusion through the structural mass.~~